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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/888,972	06/23/2001	Julian Norley	P-1045	9988

7590 01/14/2004  
JAMES R CARTIGLIA  
GRAFTECH INC.  
1521 CONCORD PIKE SUITE 301  
WILIMINGTON, DE 19803

EXAMINER

FISCHER, JUSTIN R

ART UNIT	PAPER NUMBER
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1733

DATE MAILED: 01/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/888,972

Applicant(s)

NORLEY ET AL.

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Examiner

Justin R Fischer

Art Unit

1733

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If no period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 04 November 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-6 and 18-31 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 18-31 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. §§ 119 and 120**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### DETAILED ACTION

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 4, 2003 has been entered.

### *Claim Rejections - 35 USC § 102 / 103*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-6, 18-22, 25-27, and 29-31 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Tzeng (US

6,482,520, of record). Tzeng is applied in the same manner as set forth in Paper Number 17, Paragraph 3.

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Tzeng discloses a process of forming a thermal interface or a heat sink for an electronic component comprising laminating a plurality of flexible graphite sheets, wherein said graphite sheets have a high degree of orientation (directionally aligned) based on the applied compression (e.g. roll pressing) [Column 3, Lines 1-15 and Column 4, Lines 1-9]. Regarding the thermal anisotropic ratio, Tzeng describes a ratio that can approach 20 to 1 or higher (Column 4, Lines 39-44), which includes the claimed ratio of at least 70. While Tzeng fails to expressly describe a ratio of at least 70, a fair reading of Tzeng suggests that high thermal anisotropic ratios can be obtained by densifying the graphite sheet and in view of the range of 20 or higher suggested by Tzeng, one of ordinary skill in the art at the time of the invention would have found it obvious to form a ratio of at least 70 depending on the intended use of the product (what degree of anisotropy desired and/or needed). It is emphasized that Tzeng specifically suggests the densifying of graphite sheet materials to obtain higher degrees of anisotropy and thus higher thermal anisotropic ratios.

Regarding claims 3, 4, 21, 22, and 27, the individual graphite sheets are formed by compressing or compacting expanded/exfoliated graphite particles prior to the formation of a laminated article. The thus formed graphite sheets are then superposed upon one another to form a unitary article and subsequently laminated (i.e. heat and pressure) [Column 10, Lines 7-10]

With respect to claims 5, 6, 19-22, Tzeng discloses that the degree of anisotropy increases upon roll pressing (calendering) of the sheet material to increased density (Column 4, Lines 28-30).

Regarding claims 18-22, 25-27, and 29, Tzeng discloses a common method of forming the flexible, graphite sheets comprising intercalating natural, graphite flakes (Column 6, Lines 3-51).

With respect to claims 30 and 31, Tzeng suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

***Claim Rejections - 35 USC § 103***

5. Claims 23 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzeng as applied to claim 21 above. Tzeng is applied in the same manner as set forth in Paper Number 17, Paragraph 4.

As previously set forth, Tzeng is directed to a process of forming a heat sink composed of a plurality of flexible, graphite sheets, wherein the planes of each graphite sheet (graphene layers) are highly oriented as a result of the applied pressure. In describing the applied pressure, Tzeng suggests that the expanded/exfoliated graphite particles are compressed or compacted, for example by roll pressing (Column 4, Lines 1-9 and Lines 45-47). While the reference fails to expressly describe the use of a die press or movable platen, these techniques represent well known and conventional "compacting" means and one of ordinary skill in the art at the invention would have readily appreciated the use of either technique in the process of Tzeng, especially in view of the general description by Tzeng noted above. In addition, the roll pressing or calendaring of Tzeng is only exemplary and suitable compression or compacting would equally be obtained by a conventional die press or movable platen, there being no evidence of unexpected results to establish a criticality for either of these techniques.

6. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tzeng as applied to claim 18 above and further in view of Mercuri (US 5,902,762, of record). Tzeng and Mercuri are applied in the same manner as set forth in Paper Number 17, Paragraph 5.

In describing the laminating of the individual graphite sheets, Tzeng suggests that a pressure sensitive adhesive can be used (Column 7, Lines 1-14). The reference, however, fails to suggest that the individual graphite sheets can be resin impregnated. Mercuri, though, is similarly directed to the use of flexible graphite sheets due to their desirable heat transfer properties, wherein the sealability of said graphite sheets is

improved by resin-impregnating said sheets (Column 2, Lines 1-16). In particular, Mercuri recognizes that the anisotropy of said flexible, graphite sheets allows the resin to flow readily within the sheet in a direction that is transverse to planes of the graphite particles. As such, one of ordinary skill in the art at the time of the invention would have readily appreciated applying resin to the individual graphite sheets of Tzeng, in view of Mercuri, for the benefits detailed above, particularly the improvement in sealability/heat transfer properties.

7. Claims 1 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade (US 4,878,152, of record) and optionally in view of Tzeng. Sauzade and Tzeng are applied in the same manner as set forth in Paper Number 17, Paragraph 6.

Sauzade is directed to a process of forming a heat sink mounting for a printed circuit board comprising a plurality of graphite sheets, wherein the particles of the graphite sheet (define graphene layers) are highly oriented in the plane of said graphite sheet, resulting in a highly anisotropic material or a material having a high lateral thermal conductivity (Column 2, Lines 56-65). While Sauzade fails to expressly define the thermal anisotropic ratio (lateral thermal conductivity to transverse thermal conductivity), Sauzade clearly desires a material having a high lateral thermal conductivity and further suggests that increased lateral thermal conductivities can be achieved by densifying a given material (transverse thermal conductivity would decrease / Figure 3 and Column 2, Lines 66+). The end result of densifying the material of Sauzade, which is expressly suggested by Sauzade, would be an increase in the thermal anisotropic ratio. Thus, depending on the intended use of the mounting and the

desired anisotropy, one of ordinary skill in the art at the time of the invention would have found it obvious to form the graphite sheets of Sauzade with a thermal anisotropic ratio of at least 70, it being emphasized that Sauzade expressly desires a high lateral thermal conductivity, which in turn directly results in a high thermal anisotropic ratio, there being no conclusive showing of unexpected results to establish a criticality for the claimed anisotropic ratio (claimed ratio is achieved by densifying, which is taught by Sauzade). Tzeng is optionally applied to evidence the formation of graphite sheets in heat sink applications, wherein a high thermal anisotropic ratio (greater than 20) is achieved by increasing the density of the graphite sheets (Column 4, Lines 25-44).

Regarding claim 30, Sauzade suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

8. Claims 2-6, 18-27, 29, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade and Tzeng as applied in claim 1 above and further in view of Shane (US 3,404,061, of record). Sauzade, Tzeng, and Shane are applied in the same manner as set forth in Paper Number 17, Paragraph 7.

As set forth above, Sauzade discloses a process of forming a heat sink for a printed circuit board comprising joining a plurality of graphite sheets, wherein a high lateral thermal conductivity is desired. While the reference is completely silent with



respect to the specific method in which said graphite sheets are produced, one of ordinary skill in the art at the time of the invention would have readily appreciated the techniques of the claimed invention (starting materials, pressure application, intercalation/exfoliation) as they represent the well known method by which graphite sheets are commonly formed, as shown for example by Shane. Shane discloses a method of forming a graphite sheet comprising the steps of intercalating natural, graphite flakes, expansion/exfoliation of the intercalated flakes, and compressing or compacted the expanded graphite flakes (Column 3, Line 63 – Column 4, Line 74). As such, it would have been obvious to one of ordinary skill to form the graphite sheets of Sauzade in a manner consistent with that of the claimed invention in view of Shane since the claimed method is extensively associated with the manufacture of graphite sheets, as further detailed below.

Regarding claims 2-6, as stated above, the individual graphite sheets are initially compressed or compacted prior to being formed into a laminate (Column 4, Lines 50-53). Upon be superimposed upon one another, a further amount of heat and pressure would be applied to form the laminated article of Sauzade. Additionally, Shane recognizes that the degree of anisotropy increases upon compressing or compacting the sheet material to increased density (Column 4, Lines 60-70).

With respect to claims 18-27 and 29, as previously stated, Shane evidences the well known method of forming graphite sheets comprising intercalating natural, graphite flakes, expanding/exfoliating said flakes, and compressing or compacting the exfoliated particles. In describing the compression or compacting step, Shane provides an

exemplary embodiment in which a pair of superposed rolls (analogous to calendaring) are used (Column 5, Lines 70-75). While the reference fails to expressly describe the use of a die press or movable platen to achieve said compression or compacting, these techniques represent well known and conventional "compacting" means and one of ordinary skill in the art at the invention would have readily appreciated the use of either technique in the process of Sauzade, especially in view of the general description by Sauzade noted above. In addition, the roll pressing or calendaring of Sauzade is only exemplary and suitable compression or compacting would equally be obtained by a conventional die press or movable platen, there being no evidence of unexpected results to establish a criticality for either of these techniques.

Regarding claim 31, Sauzade suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

9. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade, Tzeng, and Shane as applied in claim 18 above and further in view of Mercuri (US 5,902,762, of record). Sauzade, Tzeng, Shane, and Mercuri are applied in the same manner as set forth in Paper Number 17, Paragraph 8.

The references, however, fail to suggest that the individual graphite sheets can be resin impregnated. Mercuri, though, is similarly directed to the use of flexible

graphite sheets due to their desirable heat transfer properties, wherein the sealability of said graphite sheets is improved by resin-impregnating said sheets (Column 2, Lines 1-16). In particular, Mercuri recognizes that the anisotropy of said flexible, graphite sheets allows the resin to flow readily within the sheet in a direction that is transverse to planes of the graphite particles. As such, one of ordinary skill in the art at the time of the invention would have readily appreciated applying resin to the individual graphite sheets of Sauzade, in view of Mercuri, for the benefits detailed above, particularly the improvement in sealability/heat transfer properties.

#### ***Response to Arguments***

10. Applicant's arguments filed November 4, 2003 have been fully considered but they are not persuasive.

Regarding Tzeng, applicant correctly argues that the reference fails to expressly define an anisotropic ratio of at least 70, only suggesting a ratio that "can approach 20 to 1 or higher". However, it is clearly evident from the disclosed range that Tzeng appreciates a wide range of anisotropic ratios, including those that are greater than 20. In this instance, the general disclosure by Tzeng of an anisotropic range higher than 20 does include the claimed anisotropic ratios greater than 70. It would have been within the purview of one of ordinary skill in the art at the time of the invention to appropriately select the desired degree of anisotropy as a function of the intended use of the product, it being further emphasized that Tzeng recognizes the increase in anisotropy (and thus the anisotropic ratio) as a result of densifying a given graphite sheet in an analogous manner to the claimed invention. Thus, applicant has not established any unique

processing to arrive at the claimed anisotropic ratios and as such, the claimed anisotropic ratios would have been obvious and readily obtainable by varying processing conditions (e.g. pressure and temperature). Lastly, while the lower limit of the claimed range is 3 times that of the highest ratio expressly disclosed by Tzeng, the reference clearly identifies the ability to obtain ratios that are greater than 20 as desired; clearly, the language "can approach 20 to 1 or higher" supports anisotropic ratios greater than 20.

With respect to Sauzade, applicant contends that there is no disclosure as to the anisotropic ratio and further that the reference describes an upper limit of 300 W/m°C for the lateral thermal conductivity. First, while Sauzade fails to expressly describe the anisotropic ratio, the reference specifically desires a series of graphite sheets having a high lateral thermal conductivity. This property directly corresponds to a high anisotropic ratio, which is a ratio of the lateral thermal conductivity to the vertical thermal conductivity (thickness direction). One of ordinary skill in the art at the time of the invention would have found the claimed ratios obvious depending on the desired anisotropy and thus the intended use of the product. Furthermore, Sauzade expressly recognizes, as best depicted in Figure 3, that the lateral thermal conductivity increases as a function of density, which is analogous to that set forth by the claimed invention. As to the upper limit of 300 W/m°C, this value is a function of the specific temperature and pressure used for the embodiment and thus does not represent an upper limit for the lateral thermal conductivity. In particular, the reference states "by using the temperature and pressure values given above.....lateral thermal conductivity between

200 and 300 W/m°C" (Column 4, Lines 22-28). Lastly, applicant has not provided a conclusive showing of unexpected results to establish a criticality for the claimed anisotropic ratios and further, applicant has not established any unique processing to arrive at the claimed ratios. Thus, one of ordinary skill in the art at the time of the invention would have found the claimed anisotropic ratios obvious in view of Sauzade and optionally Tzeng.

### **Conclusion**

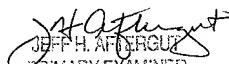
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Justin R Fischer whose telephone number is 571-272-1215. The examiner can normally be reached on M-F (7:30-4:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Crispino can be reached on 571-272-1226. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

  
Justin Fischer

January 5, 2004

  
JEFF H. AFTERGUT  
PRIMARY EXAMINER  
GROUP 1300